Modeling Formation of Microstructure

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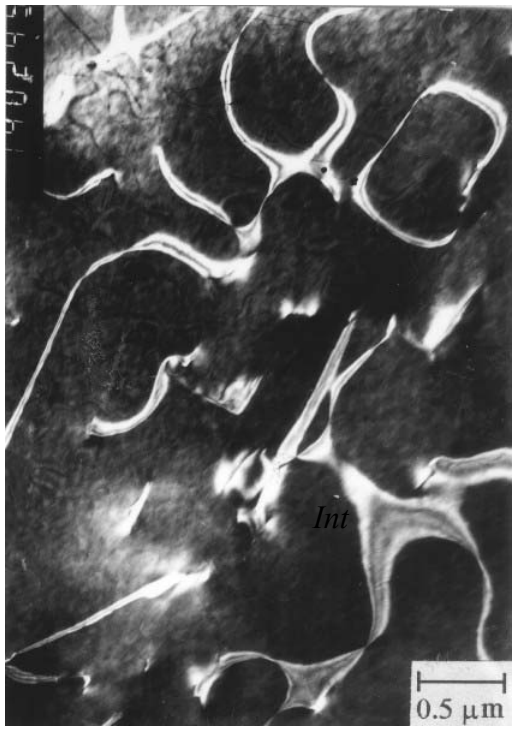
Research in Undergraduate Institutions

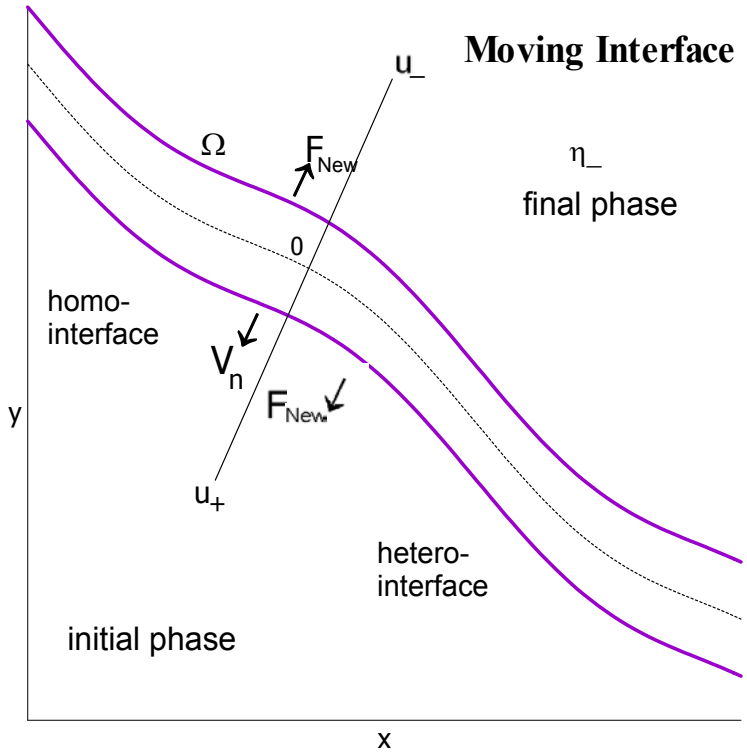
Problem: During material's processing interfaces move and create thermal effects.

Findings: 1. A unified theory of thermal effects which is applicable to completely different transformations was developed.

2. New thermodynamic force acting on an interface was revealed.

3. A number of new effects were theoretically predicted.





Outreach Activities:

1. 10th International Conference on Intergranular & Interphase Boundaries, Haifa, Israel, July 22-26, 2001.
2. 14th US National Congress of Theoretical & Applied Mechanics, Blacksburg, VA, June 23-28, 2002.

$$\underbrace{\textit{Interfacial velocity} = \textit{Driving force}}_{\text{classical theory}} + \textit{New force}$$

The New force may propel or hamper motion of the interface depending on the type of interface.

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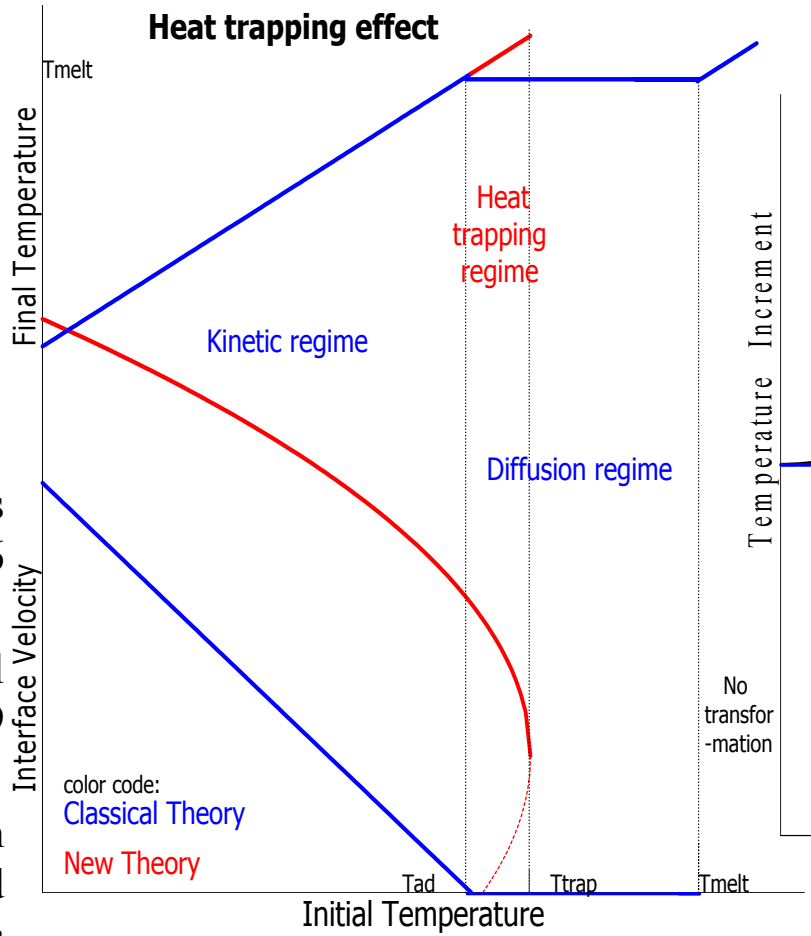
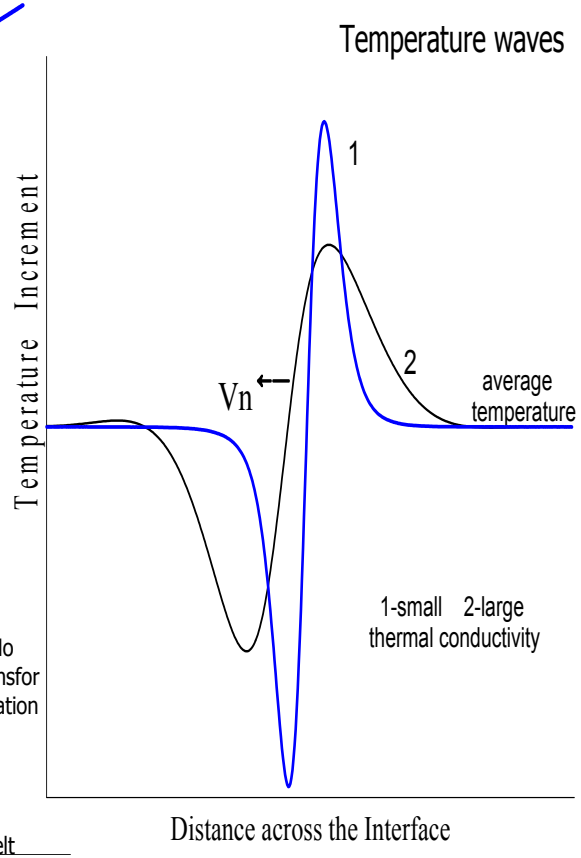
Most Important Results:

1. Heterophase interfaces: surface creation/destruction and heat trapping effects.
2. Homophase interfaces: temperature waves and thermal drag effects.





Journal Publications:

1. "Thermal effects in dynamics of interfaces" *J. Chem Phys.* **116** (2002), 4252.
2. "Thermal effects of interfacial dynamics" *Interface Science*, **9** (2001), 349.
3. "Physical analogy between continuum thermodynamics and classical mechanics" *Continuum mechanics and thermodynamics,* Submitted.

Applications: Heat trapping yields metastable materials which may be used as sensors of heat--smart materials.

Thermal waves may be visualized and used as indicators of transformations for nondestructive testing.